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GENERAL CERTIFICATE OF EDUCATION
TYSTYSGRIF ADDYSG GYFFREDINOL

MARKING SCHEME

BIOLOGY (LEGACY)
AS/Advanced

JANUARY 2009

INTRODUCTION

The marking schemes which follow were those used by WJEC for the January 2009 examination in GCE BIOLOGY. They were finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conferences were held shortly after the papers were taken so that reference could be made to the full range of candidates' responses, with photocopied scripts forming the basis of discussion. The aim of the conferences was to ensure that the marking schemes were interpreted and applied in the same way by all examiners.

It is hoped that this information will be of assistance to centres but it is recognised at the same time that, without the benefit of participation in the examiners' conferences, teachers may have different views on certain matters of detail or interpretation.

WJEC regrets that it cannot enter into any discussion or correspondence about these marking schemes.

AS MODULE BI1

Question	Answers/Explanatory Notes	Marks Available
1.	<p>A = Golgi body;</p> <p>storing / transport of lipids / assembling glycoproteins / formation of lysosomes (not: vesicles) / cell wall formation / insect cuticle formation.</p> <p>B = rough endoplasmic reticulum;</p> <p>translation / protein synthesis / packaging / form extensive transport system throughout cell</p> <p>C = nucleolus;</p> <p>site of synthesis of rRNA / production of ribosomes;</p>	<p>[2]</p> <p>[2]</p> <p>[2]</p> <p>[Total 6 marks]</p>
2.	<p>(a) (i) D = <u>phosphate</u>; E = glycerol; F = fatty acid;</p> <p>(ii) condensation reaction; elimination of a water molecule; ester bond formed;</p> <p>(iii) plasma / cell membrane; (not: membranes / phospholipid bilayer)</p> <p>(b) triglyceride has three fatty acids and phospholipid has two; no phosphate group present in triglyceride but present in phospholipid. (comparison needed)</p>	<p>[1]</p> <p>[1]</p> <p>[1]</p> <p>[1]</p> <p>[1]</p> <p>[1]</p> <p>[1]</p> <p>[Total 9 marks]</p>
3.	<p>(a) (i) A;</p> <p>(ii) C;</p> <p>(iii) B;</p> <p>(iv) F;</p> <p>(v) E;</p> <p>(vi) C;</p>	<p>[1]</p> <p>[1]</p> <p>[1]</p> <p>[1]</p> <p>[1]</p> <p>[1]</p>

Question	Answers/Explanatory Notes	Marks Available
(b)	(i) gamete; (not: sex cell / haploid)	[1]
	(ii) used in fertilization; involves fusion of nuclei; diploid number / $2n$ restored; chromosome number would double if mitosis used; lead to abnormalities in foetus;	[3 max]
	(c) independent assortment of chromosomes / random assortment; (not: random selection) random fertilization; mutation.	[2]
Any 2/3		[Total 12 marks]
4.	(a) (i) higher temperature increases <u>kinetic</u> energy of enzyme; more (successful) collisions; more enzyme – substrate complexes formed; faster production of maltose / the product / faster rate of reaction; reaches end point quicker; enzyme at 25°C converts all of substrate eventually;	[4 max]
	(ii) graph showing reverse shape; reaches zero at between 6-8 minutes;	[1] [1]
	(iii) pH / enzyme / starch concentration;	[1]
	(b) (i) 1	[1]
	(ii) at high temperatures enzyme molecules vibrate vigorously; hydrogen bonds broken; shape of active site changed; enzyme substrate complexes not formed / substrate cannot fit into active site; denatures;	[3 max]
	(iii) only four tested; only shown to be effective against milk protein (not other proteins); no results for starch / carbohydrate / fat; powder may not digest these;	[2 max]
		[Total 13 marks]

Question	Answers/Explanatory Notes	Marks Available
5.	(a) (i) plasmid / recombinant DNA;	[1]
	(ii) carries gene for insulin; into bacterium;	[1] [1]
	(b) (i) both strands of DNA are cut; staggered / leaving unpaired bases;	[1] [1]
	(ii) join with complementary bases; on other DNA fragments / plasmids; reference to role of DNA ligase;	[3 max]
	(iii) acts as a marker gene; allows bacteria that have taken up the insulin gene to be identified; because others that haven't are killed; separated and grown;	[2 max]
	(c) (i) electrophoresis;	[1]
	(ii) suspect 2 has six bars / all bands that match attacker / neither of the other two matches all six bars; (not: ref. same DNA / same genes)	[1]
	(iii) human paternity;	[1]
	[Total 13 marks]	
6.	(a) (i) alginate / cellulose;	[1]
	(ii) stabilized / re-used / cheaper, explained;	[1]
	(b) (i) allows small molecules / glucose to pass through; prevents passage of blood cells / large molecules;	[1] [1]
	(ii) no reaction with enzymes / glucose oxidase / reference enzyme specificity;	[1]
	(c) accurate / quantitative result obtained; small sample required / measure low concentrations; rapid / quick;	[2 max]
	[Total 7 marks]	

Question	Answers/Explanatory Notes	Marks Available
7.	<p>(a) (i) A. chloroplasts found only in plant cells;</p> <p>B. mitochondria found in both types;</p> <p>C. chloroplasts carry out photosynthesis / use or contain chlorophyll, mitochondria aerobic respiration;</p> <p>D. mitochondria contain cristae;</p> <p>E. chloroplasts contain thylakoid / grana / lamellae / chloroplasts may contain starch grains;</p> <p>F. chloroplast has stroma,</p> <p>G. mitochondria has matrix;</p> <p>H. both found in cytoplasm;</p> <p>I. both have double membrane;</p> <p>J. both contains DNA;</p> <p>K. both possess folded internal membranes;</p> <p>L. for location of electron carriers / enzymes / increase surface area;</p> <p>M. both possess ribosomes;</p> <p>N. both self replicating;</p> <p>O. ref. to both involved in ATP production.</p>	<p>[5 Max]</p> <p>[5 max]</p>
		[Total 10 marks]

Question	Answers/Explanatory Notes	Marks Available
7. (b)	<p>A. polymer of many nucleotides;</p> <p>B. each contains deoxyribose / pentose / 5-C sugar;</p> <p>C. plus a phosphate;</p> <p>D. contains bases adenine, guanine, cytosine and thymine (not letters);</p> <p>E. purines and pyrimidines;</p> <p>F. double helix / two chains of nucleotides twisted as helix;</p> <p>G. complimentary bases linked by hydrogen bonds;</p> <p>H. adenine with thymine and guanine with cystosine;</p> <p>I. free (DNA) nucleotides in nucleus;</p> <p>J. DNA / double helix unwinds;</p> <p>K. and unzips by breaking of hydrogen bonds / bonds between bases;</p> <p>L. reaction catalysed by DNA polymerase;</p> <p>M free nucleotides pair up to form new strand;</p> <p>N semi-conservative method.</p>	

[Total 10 marks]

AS MODULE BI2

Question	Answers/Explanatory Notes	Marks Available
1.	<p>(a) Quotas, control of mesh size, exclusion zones, closed seasons, time restriction at sea or boat numbers. Any two. (not: smaller mesh size)</p> <p>(b) The maximum size of a population/number of individuals of a species that the resources of a given area/habitat can support. (not: ref. amount/organisms)</p> <p>(c) The movement of water in/up the xylem / transpiration (flow).</p>	<p>[2]</p> <p>[1]</p> <p>[1]</p>
		[Total mark 4]
2.	<p>(a) Line 1 – Artery</p> <p>Line 2 – Capillary and Vein</p> <p>Line 3 – All three vessels</p> <p>Line 4 – Vein</p> <p>Line 5 - Artery</p> <p style="text-align: right;">One mark for each correct line = [5]</p> <p>(b) (i) Hydrostatic pressure > osmotic pressure forces liquid out of capillary / active transport / diffusion of substances (solutes)/ materials into tissue fluid.</p> <p>(ii) Osmotic pressure (wp) greater than hydrostatic pressure / water enters by osmosis; (allow: osmosis occurs) waste products move in by diffusion.</p> <p>If mention high hydrostatic pressure in b(i) and high osmotic pressure in b(ii)=1 mark</p>	<p>[2]</p> <p>[1]</p> <p>[1]</p>
		[Total mark 9]

Question	Answers/Explanatory Notes	Marks Available
3.	(a)	
	(i)	Actively transported into the guard cell (allow : pumped in) to increase turgor or decrease water potential
		[1]
		[1]
	(ii)	Outer walls thinner than inner walls (not : difference in thickness) turgor pushes outer wall outwards to open stomata (not : guard cells change shape) (mention of turgor required in either i or ii)
		[1]
		[1]
	(b)	Light / water deficiency (humidity) / temperature / carbon dioxide. (not : ref. to windspeed/daytime/night time)
		[2]

[Total mark 6]

4.	(a)	Large energy loss between one trophic level and the next means that very little would normally remain at level 5. (allow : comparison between 2000 and 0.6)	[1]
	(b)	Leaves → caterpillars → birds → hawks. (allow : Plants/ worms/ insects, not : mice) (Arrows indicating direction of energy flow must be given)	[1]
	(c)	(i)	
		80-50 = 30	[1]
		(4.5 / 30) × 100	[1]
		= 15%	[1]
		(ii)	
		Lost as excreta/urine/faeces/dead bodies	[1]
		and passes to decomposers (not : respiration)	[1]
	(d)	Primary producers	[1]
		They take up quantities of carbon dioxide (in photosynthesis).	[1]
		Decomposers.	[1]
		They generate carbon dioxide (from all the other trophic levels). (linked marks; allow : ref. to trophic levels)	[1]
	(e)	Loss of habitat / nesting sites / shelter	[1]
		Loss of biodiversity / extinction/endangered	[1]

[Total mark 13]

Question	Answers/Explanatory Notes	Marks Available
5.	(a) A.....Endodermis	[1]
	B.....Cortex	[1]
	C.....Casparian strip	[1]
	D.....Epidermis	[1]
	(b) (i) Uptake by active transport	[1]
	(ii) Symplast	[1]
	(Ions taken) into cell cytoplasm and carried through plasmodesmata	[1]
	Apoplast	[1]
	Ions carried (in solution) along/through cell walls. (allow : through gaps in cell walls; not : gaps between cell walls/holes) Need correct description with name.	[1]
	(c) (i) 500 times.	[1]
	(ii) Draws water into the plant;	[1]
	by providing a WP gradient (or osmotic potential)/powers transpiration stream.	[1]
	(iii) It blocks the apoplast pathway/passes solution into symplast/cannot travel in cell wall so forces into cytoplasm .	[1]
	(iv) (Symplast) contains living cells/plasmamembrane/cell membrane	[1]
	Allowing selective absorption to take place/regulation of ions/active uptake.(not : ref. to viruses/unwanted substances etc.)	[1]
[Total mark 15]		
6.	(a) (i) C	[1]
	(ii) B	[1]
	(b) (i) Hb gives up oxygen/releases oxygen more easily (in regions where it is required) / in areas where carbon dioxide concentration is high (not : shifts curve to right/reduces affinity of haemoglobin for oxygen)	[1]
	(ii) Allows rapid increase in uptake/more readily taken up (from alveoli). (not : converse)	[1]
	(c) Diffusion	[1]

Question	Answers/Explanatory Notes	Marks Available
6.	(d) X = Pulmonary vein	[1]
	High O ₂ blood is travelling from the lung to the heart.	[1]
	Y = Pulmonary Artery	[1]
	Low O ₂ blood travelling from the heart to the lung.	[1]
	(Credit correct explanation if X and Y incorrect)	
	(e) (i) Draw S-shape to left of printed lines	[1]
	and through the origin and not above 100,	[1]
	(ii) Because fetal Hb has greater oxygen affinity (allow : attraction/ can carry more oxygen) in order to take up oxygen from the mother's blood. (allow : from its mother/placenta)	[1]
		[1]
[Total mark 13]		
7.	(a) (i) A. community is all the living things in an area or succession refers to the way in which communities change with time	[1]
	B. bare rock colonised by pioneer species e.g. lichen/algae/bacteria;	[1]
	C. simple soil starts to form by erosion of rock;	[1]
	D. and accumulation of organic debris from primitive community of bacteria, etc	[1]
	E. mosses (and ferns) arrive;	[1]
	F. eventually followed by grasses (and herbs);	[1]
	G. small animals (invertebrates) join the community;	[1]
	H. increasing the biodiversity;	[1]
	I. shrubs / bushes appear;	[1]
	J. climax community	[1]
	K. dominated by woodland;	[1]
	(Seven marks can be awarded from the eleven available for (a) (i))	

Question	Answers/Explanatory Notes	Marks Available
7.	(a)	
	(ii)	
	L. ref. to farming practices e.g. grazing/hedging/ploughing/monoculture/herbicides (prevents establishment of larger shrubs and trees); (not : farming unequal)	[1]
	M. deforestation/large scale tree removal removes climax community;	[1]
	N. industrial activity e.g. quarrying/mining causing soil contamination/spoil heaps etc);	[1]
	O. urban development – housing roads etc; (not : ref. to fishing)(Three marks can be awarded from the four available (a) (ii).	[1]
[Total of 10 marks can be awarded out of 15]		
	(b)	
	A. all gaseous exchange takes place by diffusion across a thin membrane; (not : short diffusion pathway)	[1]
	B. this alone will supply all body cells only if the animal is very small / very thin and flattened;	[1]
	C. mention of single celled organism/Amoeba/flatworm;	[1]
	D. mention of surface area / volume ratio	[1]
	E. maintenance of concentration gradients across membrane (O ₂ in and CO ₂ out);	[1]
	F. earthworm – long, tubular shape provides large surface / volume ratio;	[1]
	G. blood transport necessary to maintain diffusion gradients/transport oxygen to tissues where required;	[1]
	H. adequate exchange areas in fish provided by gills;	[1]
	I. respiratory movement to provide flow over gills;	[1]
	J. counter current flow explained;	[1]
	K. terrestrial animals must have <u>internal</u> exchange surface;	[1]
	L. respiratory movements to aid gas exchange;	[1]
	M. (many branched) lung structure giving large surface area of alveoli;	[1]
	N. where exchange takes place;	[1]
	O. double circulation specialised for gas exchange/role of respiratory pigment i.e. picks up oxygen and increases uptake at respiratory surface.	[1]
[Total of 10 marks can be awarded out of 15]		

AS MODULE BI4

Question	Answers/Explanatory Notes	Marks Available
1.	(a) Mouth Stomach	[1] [1]
	(b) A Neutral (allow: acid or alkali) B Acid[1] C neutral (not: alkali)	[1] [1]
	(c) (i) Oxyntic cells/ cells found in gastric pits (in the mucosa) of the stomach lining; (allow: parietal cells; not: cells lining stomach) secrete hydrochloric acid.	[1] [1]
	(ii) Bile (containing sodium hydrogen carbonate); Pancreatic juice; Brunner's glands (secrete alkaline juice) / alkaline <u>mucus</u> from duodenal wall.	[2]
	(d) More than one enzyme is needed for the complete digestion of large, complex food molecules / Different enzymes have different pH <u>optima</u> / stomach is acidic i.e. re. ref to specific example (not: enzymes work at different pH)	[1]

[Total 10 marks]

2. (a) immunoglobulins/globulins (correct spelling) [1]
- (b)

ACTIVE IMMUNITY	PASSIVE IMMUNITY
Long- term/ permanent	Temporary
Memory cells	No memory cells
Antigens enter body	Antigens not involved
Antibodies produced	Antibodies injected / provided
Immune response / B lymphocytes produced	No immune response / B lymphocytes not produced

Any two pairs of differences – right column must correspond to left.

First 2 points marked even if in 1 box.

[4]

(c)

TYPE OF IMMUNITY	HOW ACQUIRED
Natural passive	<u>Antibodies</u> in breast milk (colostrum) or pass across placenta / mother to fetus
Artificial passive	Anti-serum / anti-venom / pre-synthesised antibody supplied by injection Or <u>Antibodies</u> made in another animal are supplied by injection
Natural active	Individual produces <u>antibodies</u> (and memory cells) / immune response elicited as a result of natural infection / infection by pathogen or eq.
Artificial active	Individual produces <u>antibodies</u> (and memory cells) / immune response elicited as a result of vaccination / immunisation / antigens injected

[4]

(d) (i) antigen binding sites

[1]

(ii) I. Section X is variable and highly specific/ is specific / complementary to an antigen

[1]

II. (Specific) B lymphocytes / cells recognise antigen;
(**not:** any ref. T lymphocytes)
binds to antigen;
clones/ divided by mitosis;
(**not:** divide rapidly)
produces plasma cells;
which releases antibodies.

[any three] (last 2 linked marks)

[3]

[Total 14 marks]

Question	Answers/Explanatory Notes	Marks Available
3.	(a)	
	(i) bacillus – rod shaped / a means of classifying / distinguishing bacteria.	[1]
	(ii) endemic - a disease which is always present / constant at low levels in an area / population; (not: ref. to bacteria)	[1]
	(iii) carrier – an individual <u>infected</u> by a disease organism, shows <u>no symptoms</u> (or mild symptoms) but can <u>pass the disease on</u> to another individual.	[1]
	(iv) toxin (a chemical) <u>produced by a pathogen</u> / microorganism which causes <u>damage</u> to its host.	[1]
	(b) faeces from infected person; contaminated / ref. sewage (drinking) water; (not: dirty water) via contaminated food/carried by flies to food; Carrier not washing hands before preparing food, using toilet; (not: poor hygiene) [any two]	[2]
	(c) sample of faeces / rectum; culture bacteria Some method of identification e.g. staining and microscopy / monoclonal antibodies / serology [any 2/3]	[1] [1]
	(d) sewage treatment measures; clean water supplies / not contaminated / drinking water chlorinated / purified; good food hygiene; (not: vaccination or antibiotics / uv light / sanitation)	[2]
	(e) (i) (oral) rehydration / drinking a lot of water	[1]
	(ii) (The cell wall structure / peptidoglycan / murein protected) by <u>lipopolysaccharide</u> / layer of lipoprotein (not: wall strengthened)	[1]
	(iii) broad spectrum antibiotics / tetracycline interferes with protein synthesis (carried out by all bacteria) / metabolic pathways disrupted (not: doesn't affect cell wall)	[1]
	(iv) some mention of resistance (not: the word 'immune')	[1]

[Total 14 marks]

Question	Answers/Explanatory Notes	Marks Available
4.	(a) A – substrate level B – oxidative	[1] [1]
	(b) (i) decarboxylase	[1]
	(ii) dehydrogenase	[1]
	(c) (i) X is NAD (not: NADH) Y is FAD	[1] [1]
	(ii) carrier system of FAD has two pumps / less pumps (whereas NAD has three pumps)	[1]
	(d)	

Stage	Number of ATP molecules formed from reduced hydrogen acceptors	Number of ATP molecules formed directly	Total number of ATP molecules
Link reaction	6 / 3 × 2	0	6
Krebs cycle	22	2	24

[1 each – no marks for totals] [4]

(i) acetyl CoA / acetyl coenzyme A [1]

(ii) two [1]

(iii) pyruvate, (a 3 carbon molecule) is converted to acetyl group / acetate, (a 2 carbon molecule);
by the removal of carbon dioxide / decarboxylation (and hydrogen)
(hydrogen reduces NAD);
The acetyl group combines with CoA (to form acetyl CoA) [2]

[Total marks 15]

Question	Answers/Explanatory Notes	Marks Available
5.	(a) thylakoid membrane	[1]
	(b) photosystems / P680 and P700 (not: PSI / PSII / antenna complex)	[1]
	(c) photophosphorylation (not: chemiosmosis)	[1]
	(d) (i) photolysis	[1]
	(ii) replace electrons lost from photosystem II / PSII (not: raised to higher energy level / ref. to 'going back to')	[1]
	(iii) accepted by NADP which is reduced to NADPH ₂ eq.	[1]
	(iv) accepting (or donating) electrons (not: catching electrons)	[1]
	(e) (i) Calvin cycle	[1]
	(ii) stroma	[1]
	(f) (i) C / ribulose biphosphate	[1]
	(ii) Between B and C (on line or slightly to right)	[1]
	(iii) glucose (not starch)	[1]

[Total marks 12]

Question	Answers/Explanatory Notes	Marks Available
6.	(a)	
	(i)	
	A	An artificially produced antibody; [1]
	B	That is specific for an antigen / that (binds to and inactivates) only one specific antigen); (not: produced for a specific purpose) [1]
	(ii)	
	C	Mice are exposed / injected with antigen; [1]
	D	B lymphocytes / cells / plasma cells produce an antibody (in response to the antigen); [1]
	E	collect specific (B) lymphocytes / cells / plasma cells / from spleen (cells); [1]
	F	Fuse the cancer cells / myeloma cells / tumour cells; [1]
	G	Why use these cells? Because these (myeloma) cells continually divide / ref. immortal; (not: divide rapidly) [1]
	H	The fused cells are called hybridoma cells [1]
	I	Divide (continuously) to produce clones / cells produce antibody specific antigen / clonal expansion / divide by mitosis. [1]
	[Any four from C to I]	
	(iii)	
	J	Detection – pregnancy testing; [1]
	K	To detect trace of hCG / hormone in urine; [1]
	L	Diagnostic uses – example such as blood and tissue typing, measuring drug levels, pathogen detection etc.; [1]
	M	Therapeutic uses – magic bullets explained / linking anti-cancer drugs with monoclonal antibodies so that drugs may be delivered to specific target cells / tumours; [1]
	N	Another example such as preventing organ rejection, treating auto-immune disorder, inhibition of platelet clumping after angioplasty; [1]
	O	Any detail added to any application; [1]
	[Any four from J to O]	

[Total 10 marks from the 15 available]

Question	Answers/Explanatory Notes	Marks Available
6.	(b) (i) A When a chemical process is affected by more than one factor; (allow: ref. photosynthesis)	[1]
	B Its rate is limited by that factor which is nearest its minimum value;	[1]
	C If the value of this factor is increased then the rate will also increase until some other factor becomes limiting;	[1]
	(ii) D Increasing <u>light intensity</u> will <u>increase</u> rate;	[1]
	E Light acts as an energy source for the reaction / is involved; in the light dependent stage / photolysis of water.	[1]
	F At low light intensities light is limiting;	[1]
	G At high intensities light is not limiting / other factors become limiting;	[1]
	H Suitable graph with axes labelled of rate against light intensity or description showing levelling off;	[1]
	I Carbon dioxide <u>concentration</u> ;	[1]
	J Carbon dioxide is used in the light independent reaction / Calvin cycle;	[1]
	K Suitable graph with axes labelled of rate against carbon dioxide concentration, levelling off or description;	[1]
	L Temperature change e.g. rate increases as temperature increases; (not: temperature affects photosynthesis)	[1]
	M Influences enzyme activity; (linked with point L)	[1]
	N Suitable graph of rate against temperature;	[1]
	O Graph showing two or more factors interrelated.	[1]
[A maximum of 10 marks may be awarded from the 15 available]		
(H, K, N – axes require: CO ₂ concentration; light and arrow or light intensity; temperature and arrow or temperature increasing or suitable scale / units)		



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